

PATENT SPECIFICATION



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PROVISIONAL SPECIFICATION.

Improvements in Windmills and Windmotors.

I, CHARLES ESMOND NIGHTINGALE, of 14, Rodenhurst Road, Clapham Park, London, S.W. 4, British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to a method of controlling the direction of flow of the air, in the vicinity of, and through, a wind wheel, by means of cylinders or of truncated cones, of aerofoil or other suitable section, disposed in suitable positions with regard to the wind wheel. The object of the invention is to increase the effective disc area of the wind wheel; to increase the efficiency of the blades, and to improve the outflow characteristics of the wheel, so further improving the efficiency.

It is known that an aerofoil influences the direction of the flow of air in its vicinity, and my invention is intended to apply this knowledge for the improvement of wind-mills, by directing the path of the air across certain parts of the blades and thereby improving the aerodynamic efficiency of the blades.

This improvement can be made to manifest itself (1) by a reduction in the "drag" component resolved along the resultant air direction, so causing this resultant to approach more nearly to a direction normal to the air flow, (2) by increase in the propelling properties of the blade due to improved overall aerodynamic efficiencies, and (3) by the reduction or elimination of losses caused by the undesirable alteration of the direction of flow of air by changing this undesirable flow direction into paths giving the desired characteristics for the blade sections employed. In connection with the last point, it has been shown that a plane or suitable aerofoil section fixed at or near the tip of an aerofoil and in a plane approximately at right angles to it neutralises these losses.

Another object of this invention is to

increase the effective range of working "angles of attack" or "angles of incidence" between blade and resultant air direction, by the control of the different directional air streams, through and around the wheel.

According to one form of my invention I place around the periphery of the blades of a wind actuated wheel, an open ended truncated cone or cylinder, the axis of which is concentric with, or parallel to, that of the wind wheel. The sectional shape of this cone is that of an aerofoil, the leading edge (and in cones the larger diameter) of which faces the direction of the entry of the wind. The position of this cone along the wheel axis may be such that the plane containing its leading edge is behind, co-incident with, or in front of the plane containing the leading edges of the blade tips.

In another form, the cylinder or cone placed axially as aforesaid may be of any diameter between that of the blade tips or of the blade root, or there may be two or more such cones concentrically disposed.

The cylinder or cone or cones may be supported either by a framework fixed to the bearings or other parts supporting the axis of the wheel, either in front or behind the latter, or said cone or cones may be supported by attachment to the blades themselves, either at their periphery or elsewhere.

In either of the above mentioned methods of support the cone may be continuous round its periphery or divided into sections.

In conjunction with the above cylinder, cone or cones a stream lined shaped body composed of two smaller cones with their axes in line and either parallel to or coincident with that of the windwheel is disposed with one of the cones in front of the windwheel and the other behind it. The larger diameter of each said cone is

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placed facing the windwheel, and the smaller ends facing away from it, the aforesaid larger diameter being approximately the same as that of the roots of the blades. Preferably the rear cone is arranged to rotate with the wheel, while the forward cone is stationary, being sup-

ported by the structure carrying the wheel axis.

Dated this 3rd day of January, 1923. 10

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Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in Windmills and Windmotors.

15 I, CHARLES ESMOND NIGHTINGALE, of
14, Rodenhurst Road, Clapham Park,
London, S.W. 4, British subject, do
hereby declare the nature of this inven-
tion and in what manner the same is to
20 be performed, to be particularly described
and ascertained in and by the following
statement:—

This invention relates to a method of
controlling the direction of flow of the
25 air, in the vicinity of, and through, the
wind wheel of a windmill or wind motor
by means of one or more rings of cam-
bered cross section, hereinafter referred
to as "aerofoils", the position of maxi-
30 mum camber being at about 0.3 to 0.4
of the chord of the curve measuring from
the leading edge. This ring or rings is
or are disposed adjacent the vanes of a
single rotary wind wheel and is or are of
35 a width not more than twice that of the
vane tips of such wind wheel. The dia-
meter at the inlet side is thus the same
or preferably less than that at the outlet
side of the ring. The object of the
40 invention is to increase the efficiency of
the blades. Another object of this inven-
tion is to increase the effective range of
working "angles of attack" or "angles
of incidence" between blade and air
45 direction, by the control of the different
directional air streams through and
around the wheel.

It is known that an object of curved
cross-section influences the direction of
50 the flow of air in its vicinity, and my
invention is intended to apply this know-
ledge for the improvement of windmills,
by directing the path of the air across
certain parts of the blades and thereby
55 improving the aerodynamic efficiency of
the blades.

This improvement can be made to
manifest itself (1) by increase in the pro-
pelling properties of the blade due to
60 improved overall aerodynamic efficien-
cies, and (2) by the reduction of elimin-
ation of losses caused by the undesirable
alteration of the direction of flow of air
by changing this undesirable flow—direc-
65 tion into paths giving the desired charac-
teristics for the blade sections employed.
In connection with the last point, it has

been shown that a plate or strip of curved
cross section fixed at or near the tip of
an aeroplane wing and in a plane approxi-
mately at right angles to it, tends to
neutralise these losses. 70

A further advantage which is obtained
by the use of my invention consists in
that it enables the use of a tail for keep-
75 ing the plane of the wind wheel perpen-
dicular to the direction of the wind, to
be dispensed with if so desired, since the
sensitivity of such a wheel to changes in
the direction of the wind is very high. 80

According to one form of my inven-
tion, I place around the periphery of the
blades of a wind actuated wheel, a wing
which is of cambered cross-section and the
85 axis of which is concentric with that of
the wind wheel. The position of this
ring along the wheel axis may be such
that the plane containing the edge facing
the wind is behind, co-incident with, or
90 in front of the plane containing the
edges of the blade tips.

In another form, the ring placed
axially as aforesaid may be of any dia-
meter between that of the blade tips and
that of the blade root, or there may be
95 two or more such rings concentrically
disposed.

The ring or rings may be supported
either by a framework fixed to the bear-
ings or other parts supporting the axis
100 of the wheel, or said ring or rings may
be supported by attachment to the blades
themselves or by spokes, either at their
outer ends or at intermediate positions
along the same. 105

In either of the above mentioned
methods of support, the ring may be con-
tinuous round its periphery or divided
into sections.

In conjunction with the above ring or
110 rings, a stream line shaped body com-
posed of two smaller cones with their
axes in line and coincident with that of
the windwheel is disposed with one of
the cones in front of the windwheel and
115 the other behind it. The larger dia-
meter of each of said cones is placed
facing the wind wheel, and the smaller
ends facing away from it, the aforesaid
larger diameter being approximately the 120

same as that of the roots of the blades. Preferably one cone is arranged to rotate with the wheel, while the other cone is stationary, being supported by the structure carrying the wheel axis.

In the accompanying drawing:—

Figure 1 is a sectional view of a windmill having my invention applied thereto, and

Figure 2 is a partial sectional elevation of another form of aerofoil.

Figure 3 is a perspective view of a modified form of wind wheel.

Figure 4 is a similar view to Figure 1 illustrating a modification.

Figure 5 is a perspective view showing a further modification.

Referring to Figures 1 and 2, A is an annular aerofoil secured to the ends of the blades B, B of a windwheel B, C, the hub C of which is provided with an extension D of stream line form. The shaft C' of the wheel turns in a coaxial support E of stream line form which is rotatably mounted on a tubular standard F, so as to enable its axis to maintain itself in the direction of the wind. Through the tubular standard F there may extend the shaft F' driven by the wheel, this shaft being connected to the windwheel shaft by bevel spur gear C'', F'' or by any other suitable means. The arrow G indicates the direction of the wind.

In the modification shown in Figure 3, two annular aerofoils A¹ and A¹¹ are employed attached to the blades or vanes B, B, the construction being otherwise the same as that shown in Figures 1 and 2.

Figure 4 shows a form of construction wherein the annular aerofoil H is stationary and is attached to the framework J supporting the wheel shaft by means of rods or brackets K, K.

In Figure 5, a further modification is shown wherein the aerofoil is made in the form of separate arcs or sections L, L each mounted on the end of a blade B.

I am aware that it has already been suggested to make a fan or blower wherein the vane wheel rotates in a casing of curved form in cross-section, *e.g.* it has a bell shaped entrance portion and a cone-shaped discharge portion, the smaller end of the cone being inside, and wherein the hub of the vane wheel has arranged coaxially therewith a stationary cone for the purpose of stream lining the hub; and also that it has been suggested to mount a ring of curved or conical cross-section on the blades of the rotor of a fan for ventilation, the circum-

ference of such ring being greater at the delivery than at the inlet side. It has moreover been suggested to make a wind turbine wherein there is a stationary series of blades facing a rotary series of blades, both series of blades being arranged in a *vena contracta* having a large conical extension at each side. I therefore do not wish to claim such apparatus.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A windmill or windmotor wherein an annular aerofoil is arranged adjacent to the vanes of a single rotary wind wheel and is of a width not more than twice that of the vane tips of such wind wheel, the maximum camber of the aerofoil being arranged at a distance of from 0.3 to 0.4 of its chord from the inlet end, for the purposes specified.

2. A constructional form of the apparatus claimed in Claim 1, wherein the annular aerofoil is secured to the blades of the wind wheel.

3. A constructional form of the apparatus claimed in Claim 1, wherein the aerofoil is secured to the frame supporting the axis of the wind wheel, substantially as described.

4. A constructional form of the apparatus claimed in Claim 1, wherein the aerofoil is made in separate arcs or sections each of which is mounted on the end of a blade, substantially as described.

5. A constructional form of the apparatus claimed in any of Claims 1 to 4, wherein the hub of the wind wheel is provided at each end with a coaxial extension of stream line form.

6. A constructional form of the apparatus claimed in Claim 5, wherein the stream line extension on one end of the hub is made part of the non-rotary support of the wind wheel, substantially as described.

7. The forms of my improved apparatus constructed substantially as hereinbefore described with reference to Figures 1 and 2 or to Figures 3 and 4 of the accompanying drawing, for the purposes specified.

Dated this 3rd day of October, 1923.

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[This Drawing is a reproduction of the Original on a reduced scale.]

